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CS562
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<p style="text-align:center">Assignment 1 - Kids in the Yard
Reflection</p>

Awad distinguishes between different "types" of AI. What classification scheme does the paper use and why do these types matter for scientific research? (yellow)

Awad uses a classification scheme to organize the different types based on their approach to learning, inference, and knowledge representation. Based on this information, she divides AI models into three categories: foundational, decision-oriented, and cross-cutting. Together, these paradigms meet a broad range of scientific objectives allowing scientists to execute tasks from classification and simulation to exploration and explanation.

Foundational AI - Descriptive AI, Predictive AI and Generative AI. Descriptive AI can interpret large sets of data by looking for patterns and underlying themes. Scientists use this data when they need to explore what insights the data holds. Generative AI can create content based on scientific research and even simulate experiments, and protect patient privacy, allowing scientists to gather data faster and develop a stronger evidence base for decision making. This allows scientists to build more accurate experiments,

Decision-oriented - optimization AI and prescriptive AI. Optimization AI allows scientists to run experiments more efficiently and sometimes without human intervention. The system lowers the cost of experiments because it identifies what data is important and only analyzes those pieces. This allows scientists more freedom to test, explore and predict outcomes without the need for costly and time-consuming tasks. Prescriptive AI can be used by scientists to see where they should focus their efforts. Optimization allows scientists to come to conclusions faster and develop more ideas and predictions to advance scientific research utilizing the data produced by prescriptive AI. Overall, this means scientists can spend their time on projects that will continue to advance science.

Cross-cutting - privacy-aware AI, causal AI, and explainable AI. Causal inference and explainable AI work together to ensure that AI outputs are easily interpreted and can be replicated to support a hypothesis. These are the key pieces scientists need when conducting research.

One of the biggest concerns people have about AI is the risk of their data being leaked. However, privacy-aware AI is specifically made to protect people's data - which the article notes is specifically helpful with public health. I think this matters greatly for scientific research because there are many studies based on human and classified data. In the past, researchers would hit walls due to a worry of violating privacy laws. Privacy-aware AI helps mitigate that risk.

Does Awad make a clear distinction between AI as a tool and AI as a scientific collaborator? If so, what are the differences and what are some examples given to support the differences? Do these examples suggest a real shift in how science is conducted, or mostly an extension of existing methods?(green)

For most of the article Awad speaks about AI as a tool and the ways researchers can use the various AI models to advance scientific research more efficiently which further allows them to increase the amount of research they are able to get done. For example, privacy-aware AI allows scientists more access to data and the ability to share data without there being a concern of that information leaking. This allows them to collect more data that can help them form a stronger hypothesis and testing base. Decision-oriented AI allows researchers to save money and focus on the data that is most useful to them. It also analyzes and guides scientists towards the path that will be the most beneficial. Allowing researchers to set up new projects and experiments quickly.

However, she does touch on AI as a collaborator. The article briefly speaks about it giving the impression that it is a fairly new thing. The difference between the two is that AI as a tool is mostly used under the guidance of researchers. While AI as a scientific collaborator is AI systems that can work autonomously to design, execute, and communicate experiments that meet scientific goals. Awad notes their behavior is similar to a junior researcher. However, AI grows and changes fast, so I think AI can offer more experience than a junior researcher. These AIs don't just act as a tool but are growing to a point where they can collaborate, communicate, and guide other researchers. There are some companies that are beginning to use partially autonomous LLMs such as LilaSciences and Google Co-Scientists.

Based off this information, I could see a potential impactful shift in how science is conducted, particularly since there are companies who are already working on these items. But I still feel humans will be a core part of the scientific community. While AI has the ability to access data to learn anything, there are some things I think skilled researchers know that AI can't learn. I somewhat imagine this to be like Jarvis and Iron Man. Jarvis is very much a design partner for Iron Man, but has capabilities that make it more human-like. They have collaborative conversations and work off each other to build something. I think this is what we will start to see in labs. Agents that can collaborate and guide researchers like an insightful co-worker. I also think they will be used to perform experiments or handle material that is dangerous to humans, making scientific research safer.

What are some limitations or risks of using AI in science? How do these relate to issues such as interpretability, bias, reproducibility, or theory formation?(blue)

Foundational AI can be very helpful to scientists when analyzing large amounts of data, making predictions, and generating content to both aid in experiments and creating new scientific material. However, there are some noted issues with the technology. If the correct model is not used, scientists can receive data with no transparency, meaning they cannot trust and verify the result. There is also an issue of the tool producing results based on gender and race

stereotypes. This is a common issue with models trained on historical data. This also poses a question of whether the data is accurate and ethical. There is also an issue of validation and LLMs hallucinating and fabricating citations and making misleading claims. This puts scientists in a risky spot of putting out misinformation that can weaken trust in science. All this makes me question, how much is this truly helping? It does improve efficiency, but are you trading accuracy for efficiency? How easily are scientists able to identify the corrupted data and remove it from their results?

Decision-oriented AI is allowing scientists to complete research and experiments faster because the AI examines the data and learns which data points are the most important. However, it requires a large amount of computing power. This can create a barrier for labs and scientists that do not have access to a data center, they would struggle to implement this model.

Explainable AI can be very helpful when researchers encounter issues with "black box" models. Scientists only see the output and not the data that was used, so they are unable to replicate and verify results. Explainable AI theoretically can help researchers see the data that was used. However, they have also discovered that the explanations can be misleading or wrong - leading to a lack of trust in the material.

According to Awad's arguments, is AI more likely to accelerate scientific discovery or to reshape the scientific method itself? Do you agree or disagree?

Awad speaks highly of how AI tools are accelerating scientific discovery and all the wonderful ways it is helping traditional researchers advance. However, it's really on the last page that she states that AI is transforming the scientific method. It allows more trust and transparency in the process and makes it easier for people to collaborate across the industry. It is also ensuring the safety of our data which is a huge concern today.

I agree with her. Over the next few years, I believe we are going to see almost every industry incorporating AI. This is how humans are currently advancing. But I think about the overall impact this could have specifically in science. This has the potential to not only advance human discovery, and thinking on an individual level, it also offers safety. If AI is able to run an experiment autonomously, we can remove human testers from dangerous experiments. Additionally, I think there is a possibility that we could stop animal and human trials. I also believe this will speed up discoveries particularly in the medical field. Right now, drugs spend years being developed and go through multiple trials. I think AI could be used to shorten the time it takes to see if a drug works correctly and find a way to remove humans from the testing process. Humans would only be introduced once the product is safe to use.